

## **BRAKE ROTOR**

### **REFERENCE TO RELATED APPLICATION**

- [1] The present invention claims the benefit of United Kingdom (GB) Patent Application Number 0216749.2, filed July 18, 2002.

### **TECHNICAL FIELD**

- [2] The present invention relates to brake rotors, and in particular brake rotors for use on vehicles especially road vehicles, and in particular heavy road vehicles such as trucks and lorries.

### **BACKGROUND OF THE INVENTION**

- [3] Known brake rotors include a mounting flange having a plurality of circumferentially equally spaced mounting holes. The holes are used to fix the rotor to a wheel hub of the vehicle. The mounting flange includes a circular central hole which fits over various wheel hub components.
- [4] However in use, such known brake rotors can develop radial cracks between an inner edge of the mounting holes and the mounting flange central hole.
- [5] There is a desire is to produce a brake rotor which is less susceptible to developing such cracks.

### **SUMMARY OF THE INVENTION**

- [6] Accordingly, the present invention is directed to a brake rotor having an annular disc connected to an annular mounting flange, the mounting flange defining a radially inner flange wall and including a plurality of circumferentially spaced mounting holes. The flange wall includes a plurality of recesses, with each recess situated circumferentially between adjacent mounting holes. The brake rotor also includes ventilation vanes between opposing braking faces of the annular disc with at least some ventilation vanes including inner vane portions which extend inwardly of a radially inner edge of the annular disc.
- [7] It has been found that by providing recesses between each mounting hole, the hoop stresses which develop in use due to differential thermal expansion of different parts of the

brake rotor are reduced. In particular the thermal stresses in that part of the brake rotor immediately radially inside each mounting hole can be reduced to an extent such that cracks no longer form.

### **DESCRIPTION OF THE DRAWINGS**

- [8] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:
- [9] Figure 1 is an isometric view of a brake rotor according to the present invention,
- [10] Figure 2 is an axial view of the rotor of figure 1,
- [11] Figure 2A is an enlarged view of figure 2, and
- [12] Figure 3 is a cross section view of the rotor of figure 2 taken along the line A-A.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

- [13] Specific measurements are used in the description below for illustrative purposes only and are not meant to be limiting in any way. With reference to the figures, there is shown a brake rotor 10 having an annular disc 12 connected to a generally annular mounting flange 14. In particular, it should be noted that the annular disc 12 is connected via an annular region 36. The annular region 36 is a continuous annular region. In this case, the annular region 36 is connected to a brake portion 17.
- [14] The annular disc 12 has brake portions 16 and 17, which are spaced apart by ventilation vanes 18. The brake portions 16 and 17 together with the ventilation vanes 18 define ventilation holes 20. The brake portions 16 and 17 define braking faces 16A and 17A respectively.
- [15] During use, the braking faces 16A and 17A rotate within a recess of a known caliper and are typically mounted on suspension components of a vehicle. Known brake pads are mounted within the caliper and are forced into frictional engagement with the braking faces 16A and 17A via a known mechanical/pneumatic/hydraulic system to provide a braking force.
- [16] The mounting flange 14 includes a plurality of mounting holes 22 (12 holes in this example). The mounting holes are circumferentially and equidistantly spaced and have a pitch circle diameter of B (192 millimeters in this particular example).

- [17] The mounting holes have a nominal diameter of 17 millimeters and thus the inner edges of the mounting holes define a circle of diameter C (175 millimeters in this example). The mounting flange further defines a radially inner flange wall 24 in the form of an interrupted circle of diameter D (162 millimeters in this example).
- [18] The radially inner flange wall is interrupted by axial recesses in the form of grooves 26 with each groove being positioned circumferentially between adjacent mounting holes. Each groove has a substantially semicircular radially outermost end 28 (Figure 2A) with the center of the semicircle being indicated by reference numeral 30.
- [19] The centers 30 define a circle of diameter E (170 millimeters in this particular example). The radius of the semicircular end of the grooves is 7-1/2 millimeters in this example, and thus the radially outer edges of the grooves define a circle of diameter F (185 millimeters in this example). The radially innermost edge of portion 16 is positioned at a diameter G (234 millimeters in this example).
- [20] Examination of Figure 2 and the upper half of Figure 3 shows that certain ventilation vanes 18A extend radially inwardly only as far as the inner edge of portion 16. However, examination of Figure 2 and the lower part of Figure 3 shows that certain other vanes 18B extend radially inwardly passed the radially inner edge of portion 16 to a diameter H (approximately 192 millimeters in this example), thus forming an inner vane portion 32. It can be seen that inner vane portion 32 projects axially from the mounting flange 14. Furthermore, it would be appreciated that the vanes 18A are circumferentially aligned with an associated groove 26.
- [21] In this embodiment, the ventilation vanes 18 are all radially orientated. Note, however, that in further embodiments the ventilation vanes could be curved.
- [22] Consideration of Figure 3 shows that the mounting flange 14 has axially outwardly oriented faces 14A and 14B. It would be appreciated that the mounting flange 14 is offset to the left relative to the annular disc 12 when viewing Figure 3.
- [23] Furthermore, a plane defined by face 14B is situated between the planes defined by brake faces 16A and 17. Thus mounting flange 14 is offset from, but nevertheless overlaps with, the annular disc 12.
- [24] It has been found that by providing the grooves in the position as indicated, the material 34 (see Figure 3) situated between the mounting holes and the radially inner flange

wall is subject to lower thermal stresses and hence the likelihood of cracking in this region is significantly reduced.

[25] Certain aspects of the geometry of the mounting flange should be noted. In this example, the mounting hole pitch circle diameter B (192 millimeters in this example) is larger than the groove end center pitch circle diameter E (170 millimeters in this example). Further, the mounting hole pitch circle diameter B (192 millimeters in this example) is larger than the groove radially outer edge circle diameter F (185 millimeters in this example). Also, the groove end center pitch circle diameter E (170 millimeters in this example) is less than the circle diameter C (175 millimeters in this example) defined by the radially innermost portion of the mounting holes.

[26] The diameter of the circle F (185 millimeters in this example) defined by the groove radially outer edges is larger than the diameter of the circle C (175 millimeters in this example) defined by the radially innermost portion of the mounting holes.

[27] The brake rotor, and the inner vane portions 32 in particular, is typically cast using any metal casting method. Although the grooves may also be cast, machining the grooves instead makes it easier to make the radially outer edge circle diameter F to be smaller than the circle H defined by the inner edge of the inner vane portions 32. This allows for machining of the rotor flange without requiring machining of the inner vane portions 32 as well.

[28] It should be understood that various alternatives to the embodiments of the invention described herein may be employed in practicing the invention. It is intended that the following claims define the scope of the invention and that the method and apparatus within the scope of these claims and their equivalents be covered thereby.